

Final Project Report
Justification for Delisting Waddell Creek, East Fork,
for Nutrients, Santa Cruz County, California

June 14, 2004

California Regional Water Quality Control Board, Central Coast
Region

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Appendix A- Nutrient Survey Forms

1. Project Definition

The east fork of the Waddell Creek was listed as impaired for nutrients in 1990. The creek was listed because of ammonia violations at the NPDES facility, California Department of Parks and Recreation, Big Basin Redwoods State Park Wastewater Treatment Plant. Another reason for the listing was the California Department of Fish and Game issued a report in 1980 indicating dense growths of filamentous algae were growing downstream of the treatment plant in sunlight areas. They attributed the algal growth to nutrients.¹

Ammonia discharge violations have reoccurred in the past but no violations have occurred since 2002. Ammonia is converted to nitrate through the nitrogen cycle and becomes available as a possible promoter of plant growth. Since the listing in 1990, the treatment plant has been upgraded. The upgrade included the addition of clinoptolite filtration for ammonia removal. The table below shows a record of historical ammonia violations since 1998. Ammonia violations have dramatically decreased since then.

Table 1. Number of Unionized Ammonia Violations Since 1998

Year	Number of Violations
1998	6
1999	4
2000	20
2001	9
2002	1
2003	0
2004 (Jan-Apr)	0

2. Watershed Description

Waddell Creek is located in Santa Cruz County, California approximately two-thirds of the way from San Francisco to Monterey Bay. The figure below shows the location of the Waddell Creek watershed.

¹ Reference: *Waddell Creek Survey*, California Department of Fish and Game, September 1980

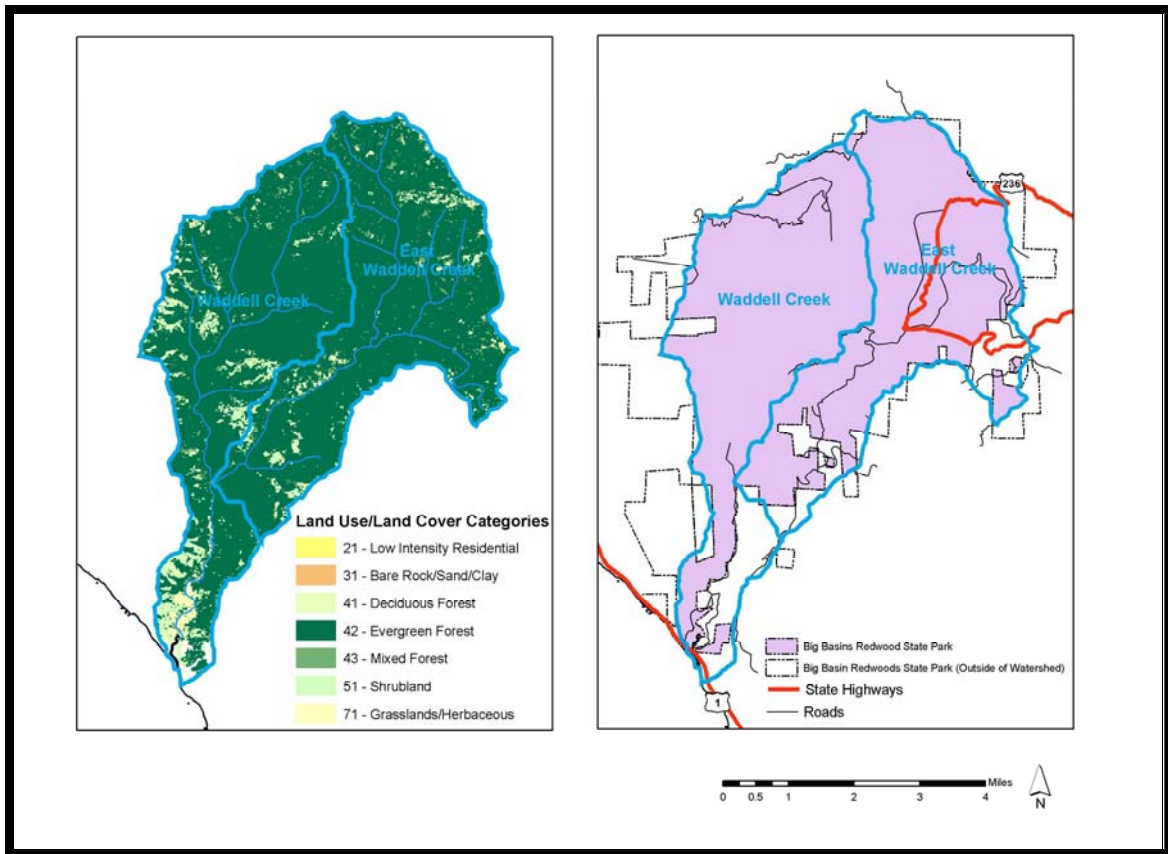
Figure 1. Waddell Creek Watershed Location



Waddell Creek originates in the Redwood Belt of the Santa Cruz Mountains at an altitude of 1,500 to 2,300 feet. The headwaters experience a great deal of precipitation during winter months. The headwaters portion of Waddell Creek has a mean annual rainfall of between 55 and 60 inches. The lower portion of the watershed receives much less rainfall of approximately 30 inches near the coast.² The California Big Basin State Park occupies approximately 85% of the Waddell Creek watershed as shown below. The California Big Basin State Park also occupies approximately 85% of the east Fork of Waddell Creek as shown below.

² California Department of Fish and Game Fish bulletin No. 86, *The Life Histories of the Steelhead Rainbow Trout (Salmo gairdneri) and Silver Salmon (Oncorhynchus kisutch) with Special Reference to Waddell Creek, California and Recommendations Regarding their Management*, 1954

Figure 2. Waddell Creek Watershed Land Use



The table below shows the land use acreage and land use type by percentage in the East Waddell Creek watershed and the entire Waddell Creek watershed.

Table 2. Land Uses in the East Waddell Creek and Entire Waddell Creek Watersheds

Watershed A	Watershed Area (Acres) B	Land Use/Land Cover (LULC) Category C	LULC Area D	Percent (D/B)*100 E
East Waddell Creek	7607	21 - Low Intensity Residential	5	0.06%
	7607	41 - Deciduous Forest	28	0.37%
	7607	42 - Evergreen Forest	6,961	91.51%
	7607	43 - Mixed Forest	211	2.78%
	7607	51 - Shrubland	314	4.13%
	7607	71 - Grasslands/Herbaceous	81	1.07%
	7607			
Waddell Creek	7830	21 - Low Intensity Residential	14	0.18%
	7830	31 - Bare Rock/Sand/Clay	4	0.06%
	7830	41 - Deciduous Forest	29	0.37%
	7830	42 - Evergreen Forest	6,601	84.30%
	7830	43 - Mixed Forest	160	2.05%
	7830	51 - Shrubland	702	8.96%
	7830	71 - Grasslands/Herbaceous	202	2.58%

3. Beneficial Water Uses and Water Quality Objectives

Table 3. Summary of Beneficial Water Uses for Waddell Creek

Waterbody Names	MUN	AGR	PRO	IND	GWR	REC1	REC2	WILD	COLD	WARM	MIGR	SPWN	BIOL	RARE	EST	FRESH	NAV	POW	COMM	AQUA	SAL	SHELL
Waddell Creek Estuary					X	X	X	X	X		X	X	X	X	X				X			X
Waddell Creek (Main Stem)	X	X		X	X	X	X	X	X		X	X	X	X		X			X			
Waddell Creek, east branch	X				X	X	X	X	X		X	X	X	X		X			X			
Waddell Creek, west branch	X				X	X	X	X	X		X	X	X	X					X			

Beneficial Use abbreviations used: Mun=Municipal and Domestic Supply, Agr= Agricultural Supply, Proc=Industrial Process Supply, Ind=Industrial Service Supply, GWR=Ground Water Recharge, Rec-1=Water Contact Recreation, Rec-2=Non-Contact Water Recreation; Wild=Wildlife Habitat; Cold=Cold Fresh Water Habitat, Warm=Warm Fresh Water Habitat, Migr=Migration of Aquatic Organisms; Spwn=Spawning, Reproduction, and/or Early Development; Biol=Preservation of Biological Habitats of Special Significance, Rare=Rare, Threatened, or Endangered Species, Est=Estuarine Habitat, Frsh=Freshwater Replenishment, Nav=Navigation, Pow=Hydropower Generation, Comm=Commercial and Sport Fishing, Aqua=Aquaculture, Sal=Inland Saline Water Habitat, Shell=Shellfish Harvesting, ASBS=Areas of Special Biological Significance

The *Water Quality Control Plan, Central Coast Region* (Basin Plan), contains the following unionized ammonia objective:

“The discharge of wastes shall not cause concentrations of unionized ammonia (NH₃) to exceed 0.025 mg/l (as N) in receiving waters.”

The *Water Quality Control Plan, Central Coast Region* (Basin Plan), contains the following narrative objective:

“Biostimulatory Substances:

“Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.”

This objective does not prohibit biostimulatory substances; it only prohibits biostimulatory substances that cause nuisance or adversely affects beneficial uses.

Nuisance is defined within the Porter-Cologne Water Quality Control Act as:

“anything that meets all of the following requirements:

- (1) Is injurious to health, or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property.
- (2) Affects at the same time an entire community or neighborhood, or any considerable number of persons, although the extent of the annoyance or damage inflicted upon individuals may be unequal.
- (3) Occurs during or as a result of the treatment or disposal of wastes.”

The only numeric nutrient objective in the Basin Plan is for nitrate. The numeric objective for nitrate (as NO₃) is 45 mg/l. If nitrate is expressed as nitrogen, the numeric objective is nitrate (as N) is 10 mg/l. The Basin Plan does not provide phosphorus water quality objectives.

Other water quality objectives can also indicate the presence of excess biostimulatory substances. These objectives apply to dissolved oxygen and pH.

The dissolved oxygen objective contained in the Basin Plan is:

Dissolved Oxygen

The dissolved oxygen concentration shall not be reduced below 7.0 mg/l at any time.

The pH objective contained in the Basin Plan is :

For waters with coldwater beneficial use:

pH

The pH value shall not be depressed below 7.0 or raised above 8.5. Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters.

For waters with municipal and domestic water supply beneficial use:

pH

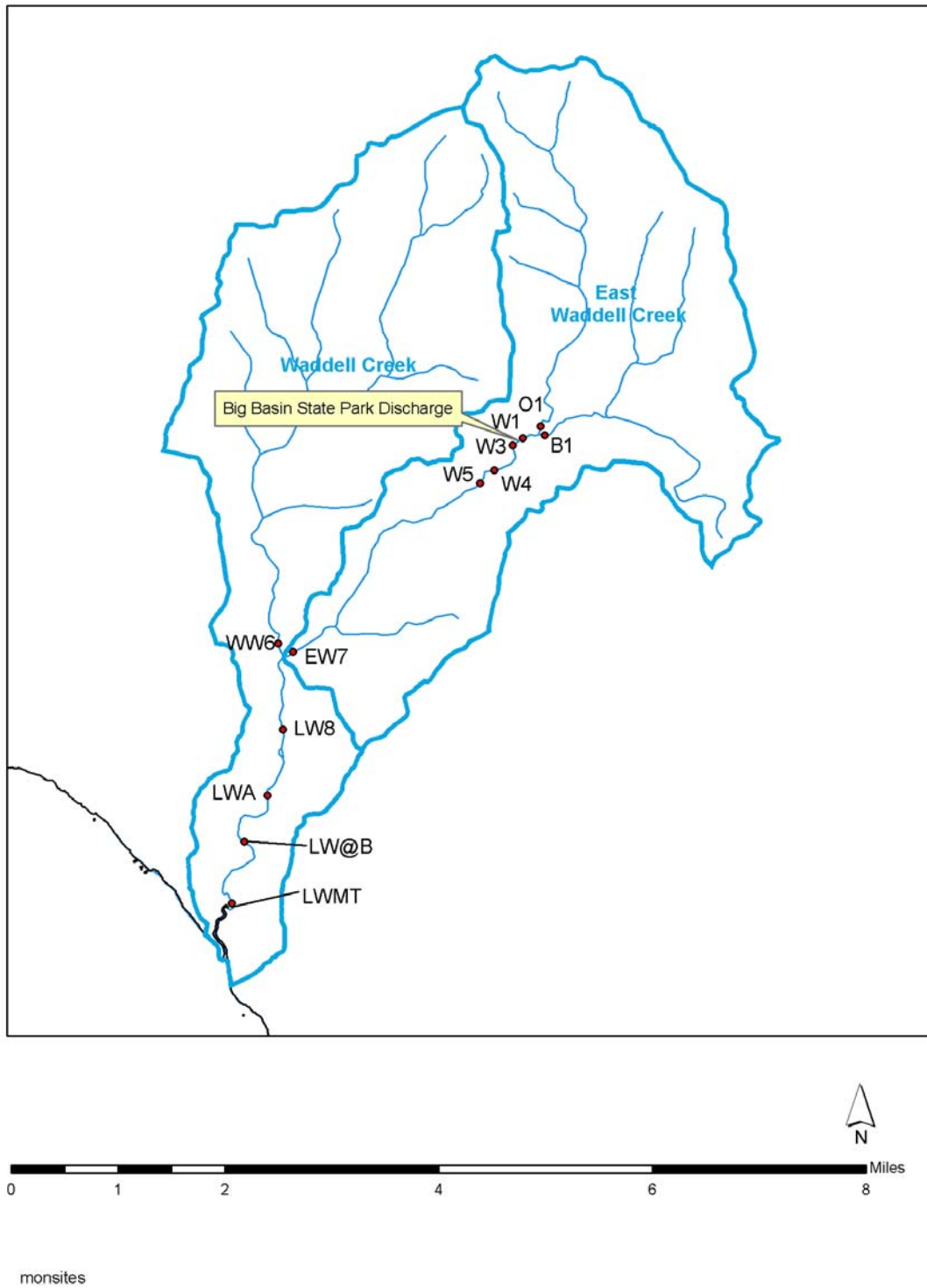
The pH value shall neither be depressed below 6.5 nor raised above 8.3.

4. Data Analysis

This section provides a summary of water quality data, flow data, and habitat quality data Regional Board staff collected.

Staff measured attainment of the water quality objective using the following approach. We sampled the creek at approximately ten stations approximately monthly. We started sampling and collecting information on September 24, 2002. We completed the sampling and collection on October 7, 2003. A map of the sampling stations is shown in Figure 3.

Figure 3. Sampling Stations



Regional Board staff collected information for the following parameters:

Dissolved Oxygen	Dissolved Oxygen (% Saturation)
pH	Nitrate
Total Nitrogen	Total Kjeldahl Nitrogen
Ammonia	Unionized Ammonia
Organic Nitrogen	Nitrite
Orthophosphate	Total Phosphorus
	Water Temperature

Regional Board staff also collected information regarding the following:

% Canopy
% Algal coverage
Substrate
Flow

For each sampling event, Regional Board staff also completed a survey form that categorizes nutrient impact upon beneficial uses.³ Staff also took pictures of algal coverage and canopy cover.

Other than percent algal coverage, these parameters were not evaluated as part of the justification for delisting.

4.1 Water Quality Data

Regional Board staff collected information at the following sites. The sites are listed in order of the most upstream station in the watershed first and continue in descending order toward the Pacific Ocean. (We were not able to obtain latitude and longitude readings at all stations. The heavy canopy prevented the Global Positioning System from functioning.)

³ The nutrient survey was obtained from United States Department of Agriculture Soil Conservation Service *Water Quality Indicators Guide: Surface Waters*, July 18, 1988

Table 4. Station Location Descriptions

Staff ID Number	Big Basin Monitoring Station Number	GPS Position ¹	Location Description
WW6		Latitude: 122.26781 W Longitude: 37.13410 N	West Waddell Creek upstream confluence of East Waddell Creek
O1			Opal Creek upstream confluence of East Waddell Creek
B1			Blooms Creek upstream confluence of East Waddell Creek
W1 ²	W1		East Branch of Waddell Creek 145 feet upstream of NPDES discharge
W3 ²	W3		East Branch of Waddell Creek 100 feet downstream of NPDES discharge
W4		Latitude: 122.23048W Longitude: 37.162 N	East Branch of Waddell Creek approximately 1000 feet upstream of old Last Chance Road bridge crossing ³
W5		Latitude: 122.23515 W Longitude: 37.15812 N	East Branch of Waddell Creek at old Last Chance Road bridge crossing ³
EW7		Latitude: 122.26682 W Longitude: 37.13393 N	East Waddell Creek upstream confluence of West Waddell Creek
LW 8		Latitude: 122.26741 W Longitude: 37.12087 N	Lower Waddell Creek ~ one mile downstream confluence of East and West Waddell Creek
LWA			Lower Waddell @ Alder Camp
LW @ B			Lower Waddell @ bridge
LWMT			Lower Waddell @ Marsh Trail

¹ GPS Positions not available for all stations for the following reasons: (a) canopy coverage prevented readouts or (b) GPS equipment was not available after some stations established

² These stations are also sampled by the California Big Basin State Park staff.

³ Road and bridge removed as part of ecosystem restoration project

A map of these stations is shown in Figure 3.

The table below provides information regarding the number of samples taken at each station, the sampling frequency, and the period of record for each station.

Table 5. Number of Samples and Sample Period

Staff Informal ID #	Number of Samples	Period of Record
WW6	5	9/24/02-10/07/03
O1	10	9/24/02-10/08/03
B1	10	9/24/02-10/08/03
W1 ¹	10	9/24/02-10/08/03
W3 ¹	7	9/24/02-10/08/03
W4	1	9/24/03
W5	9	10/30/02-10/08/03
EW7	5	9/24/02-10/07/03
LW 8	9	10/29/02-10/07/03
LWA	7	1/16/03-10/07/03
LW @ B	1	10/29/02
LWMT	5	1/16/03-07/01/03

¹These stations are also sampled by the Big Basin State Park Staff. Between April and October, nitrate, kjeldahl nitrogen, total ammonia, and unionized ammonia are sampled monthly. pH and dissolved oxygen are sampled weekly. Between November and March, nitrate and kjeldahl nitrogen are sampled quarterly. Total ammonia, unionized ammonia, pH, and dissolved oxygen are sampled monthly.

Sampling data results are presented in Section 4.4 of this report.

4.2 Flow Data

Regional Board staff also performed flow measurements at the following stations. The flow data results are not needed to support this delisting justification.

Table 6. Stations and Period of Record for Flow Data

Staff Informal ID #	Number of Samples	Period of Record
W1	9	10/30/02 – 10/08/03
W3	5	5/21/03-10/08/03
W5	9	10/30/02-10/08/03
EW7	9	10/29/02-10/07/03
LW8	9	10/29/02-10/07/03

4.3 Habitat Quality Data

Staff investigated violation of the narrative water quality objectives by evaluating nuisance and beneficial use impacts. To evaluate impacts, staff completed a nutrient survey⁴ that evaluates nutrient impacts. This form is shown in Table 7 below. The form ranks five indicators from “excellent” to “poor.” A score is assigned for each indicator at each site.

Table 8 below shows the condition of sampling stations based upon the nutrient indicator survey results.

⁴ The nutrient survey was obtained from United States Department of Agriculture Soil Conservation Service *Water Quality Indicators Guide: Surface Waters*, July 18, 1988

Table 7. Nutrient Indicators Blank Form⁴**Nutrients**FIELD SHEET 3A: NUTRIENTS
INDICATORS FOR RECEIVING WATERCOURSES AND WATER BODIES*

Evaluator _____		County/State _____		Date _____	
Water Body Evaluated _____		Water Body Location _____		Total Score/Rank _____	
Rating Item	Excellent	Good	Fair	Poor	
(Circle one number among the four choices in each row which BEST describes the conditions of the watercourse or water body being evaluated. If a condition has characteristics of two categories, you can "split" a score.)					
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	Little vegetation, uncluttered look to stream or pond. OR What's expected for good water quality conditions in your region. Usually fairly low amounts of many different kinds of plants. OTHER	Moderate amounts of vegetation. OR What's expected for good water quality conditions in your region. OTHER	Cluttered weedy conditions. Vegetation sometimes luxurious and green. Seasonal algal blooms. OTHER	Choked weedy conditions or heavy algal blooms or no vegetation at all. Dense masses of slimy white, greyish green, rusty brown or black water molds common on bottom. OTHER	
	10	6	3	0	
2. Color of water due to plants at base or low flow	Clear or slightly greenish water in pond or along the whole reach of stream. OTHER	Fairly clear; slightly greenish. OTHER	Greenish. Difficult to get pond sample without pieces of algae or weeds in it. OTHER	Very, very green pond scums. Pea green color or pea soup condition during seasonal blooms of microscopic algae in ponds. "Oily-like" sheen when pea soup algae die off. OTHER	
	9	6	3	0	
3. Fish behavior in hot weather fish kills, especially before dawn	No fish piping or aberrant behavior. No fish kills. OTHER	In hot climates, occasional fish piping or gulping for air in ponds just before dawn. No fish kills in last two years. OTHER	Fish piping common just before dawn. Occasional fish kills. OTHER	Pronounced fish piping. Pond fish kills common. Frequent stream fish kills during spring thaw. Very tolerant species (e.g. bullhead, catfish). OTHER	
	9	5	3	0	
4. Water use impacts; health effects for whole sub-watershed	None. OTHER	Minimal, such as reduced quality of fishing. OTHER	A couple of the following: Algal clogged pipes. Algal related taste, color, or odor problems with human or livestock water supply. Cattle abortion. Reduced recreational use due to weedy conditions, decay, odors, etc. OTHER	Several of the following: Algal clogged pipes. Pond fish kills common. Algal related taste, color, or odor problems with human or livestock water supply. Cattle abortion. Reduced quality of fishery. Reduced recreational use due to weedy conditions, decay, odors, etc. Blue babies—incidence of methemoglobinemia due to high nitrate levels. Property devaluation. OTHER	
	8	7	4	2	
5. Bottom-dwelling aquatic organisms	Intolerant species occur: mayflies, stoneflies, caddisflies, water penny, riffle beetle. High diversity. OTHER	Intolerants common. A mix of tolerants: shrimp, damselflies, dragonflies, black flies. Moderate diversity. OTHER	Mainly tolerants: snails, shrimp, damselflies, dragonflies, black flies. Mainly tolerants, but some very-tolerants. Intolerants rare. Reduced diversity with occasional upsurges of tolerants, e.g. tube worms, and chironomids. OTHER	Mainly very-tolerants: midges, crane flies, horseflies, rat-tailed maggots, or no organisms at all. Very reduced diversity, upsurges of very-tolerants common. OTHER	
	9	7	3	1	

*The effects of nutrients may be "masked" by high sediment loads, creating sufficient turbidity to shade light-dependent aquatic vegetation. This may cause aquatic vegetation, a water quality indicator, to die and disappear from the watercourse. To obtain accurate nutrient levels in high sediment situations, chemical testing may be necessary. Under these circumstances you should contact a local or other water quality specialist.

1. Add the circled Rating Item scores to get a total for the field sheet.

TOTAL []

2. Check the ranking for this site based on the total field score. Check "excellent" if the score totals at least 38. Check "good" if the score falls between 23 and 37, etc. Record your total score and rank (excellent, good, etc.) in the upper right-hand corner of the field sheet. If a Rating Item is "fair" or "poor," complete Field Sheet 3B.

RANKING Excellent (38-45) [] Good (23-37) [] Fair (9-22) [] Poor (8 or less) []

Table 8. Nutrient Indicator Survey Results

DATE	TOTAL SCORE/ RANKING	STATION									
		WW6	W1	W3	W5	~ 1500 Feet Upstream of EW7	~200 Feet Upstream of EW7	EW7	LW8	LWA	LWMT
October 29/30, 2	Total Score	39	(1)	(2)	44	(2)	(2)	41	41	(2)	(2)
	Ranking	Excellent	(1)	(2)	Excellent	(2)	(2)	Excellent	Excellent	(2)	(2)
January 16 and 17, 2003	Total Score	(1)	(1)	(2)	(1)	(2)	(2)	(1)	(1)	(1)	(3)
	Ranking	(1)	(1)	(2)	(1)	(2)	(2)	(1)	(1)	(1)	(3)
March 25 and 26, 2003	Total Score	(1)	(1)	(2)	(1)	(2)	(2)	(1)	(1)	(1)	(3)
	Ranking	(1)	(1)	(2)	(1)	(2)	(2)	(1)	(1)	(1)	(3)
April 30 and May 1, 2003	Total Score	(1)	(1)	(2)	(1)	(2)	(2)	(1)	(1)	(1)	(2)
	Ranking	(1)	(1)	(2)	(1)	(2)	(2)	(1)	(1)	(1)	(2)
May 20 and 21, 2003	Total Score	45	(4)	(5)	45	(1)	44	44	43	(1)	(3)
	Ranking	Excellent	(4)	(5)	Excellent	(1)	Excellent	Excellent	Excellent	(1)	(3)
July 1 and 2, 2003	Total Score	45	(1)	44	44	45	44	45	45	45	(3)
	Ranking	Excellent	(1)	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	(3)
July 22 and 23, 2003	Total Score	45	44	44	44	45	44	45	45	45	(3)
	Ranking	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	(3)
September 17 and 18, 2003	Total Score	(1)	(1)	44	41	45	40	45	45	43	(3)
	Ranking	(1)	(1)	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	(3)

DATE	TOTAL SCORE/ RANKING	STATION									
October 7 and 8, 2003	Total Score	45	(1)	44	43	45	30	45	43	43	(3)
	Ranking	Excellent	(1)	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	(3)

Foot notes:

(1) No fish observed, therefore total score is not obtainable. However, all other indicators range from good to excellent. (Please refer to survey form in the appendix for more information.)

(2) Not surveyed

(3) Not able to evaluate all indicators because this is a depositional zone. However, all evaluated indicators range from good to excellent. (Please refer to survey form in the appendix for more information.)

Unknown, depositional zone (silt covered)

(4) Not able to evaluate fish behavior because only one fry observed. However, all evaluated indicators range from good to excellent. (Please refer to survey form in the appendix for more information.)

(5) Not able to evaluate benthic macroinvertebrates because only one caddisfly observed. However, all evaluated indicators range from good to excellent. (Please refer to survey form in the appendix for more information.)

In addition to the information above, the California Big Basin State Park NPDES facility also collects benthic macroinvertebrate data in the vicinity of the discharge once per year. In 2001, substrate baskets are placed upstream and downstream of the discharge for 75 days beginning in August. Three baskets were placed upstream. The farthest basket was approximately 45 feet upstream of the discharge. Four baskets were placed downstream of the discharge. The farthest basket was approximately 25 feet downstream of the discharge. Results indicate that benthic macroinvertebrate assemblages more than 14 feet downstream of the effluent discharge point were similar in diversity, tolerance, and abundance to benthic macroinvertebrate assemblages upstream of the discharge. Similar results were obtained in the year 2000.⁵

Substrate baskets were placed in a similar manner in 2002 and 2003. 2002 results indicate that benthic macroinvertebrate assemblages placed more than six feet downstream of the effluent discharge point were similar in richness and diversity, were less tolerant, and had higher abundances than baskets placed upstream of the discharge.⁶ 2003 results indicate that benthic macroinvertebrate assemblages positioned at least seven feet downstream of the effluent discharge indicate a similar richness, diversity, and abundance to benthic macroinvertebrate assemblages upstream of the discharge.⁷

4.4 Data Analysis Summary

The California Big Basin State Park monitors receiving waters at stations W1 and W3 on a monthly basis. These monitoring results are shown below. The table shows there are no violations of Basin Plan numerical objectives.

⁵ Reference: *Effects of Effluent Discharge on Benthic Macroinvertebrate Assemblages of Waddell Creek , Santa Cruz County, Fall 2001*, J. Thomas King BioAssessment Services, January 2002

⁶ Reference: *Effects of Effluent Discharge on Benthic Macroinvertebrate Assemblages of Waddell Creek , Santa Cruz County, Fall 2002 (Draft)*, J. Thomas King BioAssessment Services, November 2002

⁷ Reference: *Effects of Effluent Discharge on Benthic Macroinvertebrate Assemblages of Waddell Creek , Santa Cruz County, Fall 2003*, J. Thomas King BioAssessment Services, December 2003

Table 9. California Big Basin State Park Dissolved Oxygen Monitoring Results for the East Fork of Waddell Creek¹

STATION	W1	W3	W1	W3	W1	W3	W1	W3	W1	W3	W1	W3
CONSTITUENT	pH	pH	Dissolved Oxygen	Dissolved Oxygen	Total Ammonia, as N	Total Ammonia, as N	Unionized Ammonia, as N	Unionized Ammonia, as N	Kjeldahl Nitrogen, as N	Kjeldahl Nitrogen, as N	Nitrate, as N	Nitrate, as N
Units	pH Units	pH Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
DATE												
04/26/04	7.6	7.6	10.0	9.9								
04/19/04	7.7	7.7	12.3	12.2								
04/13/04	7.8	7.9	10.3	10.2								
04/06/04	7.6	7.6	10.4	10.3	0.09	0.11	0.0010	0.0010	0.7	1.4	<0.23	<0.23
03/09/04	7.4	7.5	10.2	10.1								
03/06/04					0.09	0.11	0.0006	0.0008				
02/09/04	7.5	7.5	10.9	11.0	0.12	0.13	0.0007	0.0007				
01/21/04			10.3	10.3	0.10	0.07	0.0004	0.0003				
01/20/04	7.5	7.5										
12/09/03	7.8	7.7	10.9	10.8	0.11	0.12	0.00024	0.00025	0.6	0.8	<0.23	<0.52
11/10/03	7.7	7.7	9.9	9.9	0.28	0.17	0.0032	0.002				
10/28/03	7.7	7.8	10.3	10.0								
10/21/03	7.8	7.9	9.6	9.4								
10/14/03	7.7	7.6	9.9	9.8								
10/07/03	7.5	7.0	9.6	9.4	0.16	0.17	0.0015	0.0006	0.56	1.1	<0.23	3.00
09/30/03	7.5	7.6	9.1	9.0								
09/23/03	7.8	7.8	9.5	9.4								
09/16/03	7.6	7.6	9.7	9.6								
09/09/03	7.8	7.8	9.2	9.0								
09/02/03	7.4	7.4	9.2	9.1					0.56	1.70	<0.20	5.00
09/01/03					0.15	0.27	0.0012	0.0022				
08/27/03			8.8	8.7								
08/19/03			9.1	8.9								
08/13/03	7.8	7.8	9.1	9.0								
08/08/03	7.6	7.5	9.3	9.3								
08/05/03	7.6	7.6			<0.1	<0.1	<0.0008	<0.0008	0.45	0.84	<0.23	3.80

STATION	W1	W3	W1	W3	W1	W3	W1	W3	W1	W3	W1	W3
CONSTITUENT	pH	pH	Dissolved Oxygen	Dissolved Oxygen	Total Ammonia, as N	Total Ammonia, as N	Unionized Ammonia, as N	Unionized Ammonia, as N	Kjeldahl Nitrogen, as N	Kjeldahl Nitrogen, as N	Nitrate, as N	Nitrate, as N
Units	pH Units	pH Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
07/30/03	7.6	7.5	8.7	8.6								
07/22/03	7.4	7.5	8.9	8.9								
07/16/03	7.4	7.4										
07/15/03			8.9	8.8								
07/08/03	7.8	7.6	9.5	9.6								
07/01/03	7.5	7.6	9.3	9.2	0.06	0.05	0.0001	0.0005	0.8	6.2	<0.2	0.4
06/24/03	7.9	7.8	10.1	10.0								
06/16/03	7.6	7.6	9.9	9.8								
06/09/03	7.6	7.7	9.3	9.4								
06/03/03	7.7	7.6	9.3	9.2	0.11	0.19	0.0009	0.002	13.00	6.6	<0.23	0.6
05/27/03	7.6	7.6	9.4	9.4								
05/20/03	7.8	7.7	9.9	9.8								
05/13/03	7.6	7.6	10.4	10.4								
05/12/03									3.00	3.20	<0.25	<0.25
05/06/03	7.6	7.6	10.3	10.3	<.1	<.1	<0.0006	<0.0006				
04/29/03			10.5	(2)								
04/22/03			7.7	7.8								
04/15/03			7.7	7.6								
04/08/03			7.9	7.9								
04/02/03					<0.10	<0.10	<0.0018	<0.0018	1.80	4.10	<0.23	0.34
04/01/03	7.9	7.9	10.4	10.4								
03/27/03												
03/19/03												
03/12/03												
03/04/03	7.8	7.8	8.4	10.5	<0.1	<0.1	<0.0011	<0.0011	15.00	13.00	<0.23	<0.23
02/10/03					<0.1	<0.1	<0.0011	<0.0011				
01/14/03	7.7	7.6	9.9	9.8	<0.1	<0.1	0.0006	0.0006				
12/09/03			10.5	10.2								
12/10/03	7.9	7.8			<0.1	<0.1	<0.001	<0.001	2.0	0.7	<0.23	2.6
11/19/02	7.9	7.8			<0.28	<0.28	<0.003	<0.003				

STATION	W1	W3	W1	W3	W1	W3	W1	W3	W1	W3	W1	W3
CONSTITUENT	pH	pH	Dissolved Oxygen	Dissolved Oxygen	Total Ammonia, as N	Total Ammonia, as N	Unionized Ammonia, as N	Unionized Ammonia, as N	Kjeldahl Nitrogen, as N	Kjeldahl Nitrogen, as N	Nitrate, as N	Nitrate, as N
Units	pH Units	pH Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
11/18/02			10.4	10.4								
11/06/02			11.7	10.9								
11/05/02	8.0	7.9										
10/29/02	7.9	7.9	10.0	10.0								
10/25/02	8.3	8.2	9.9	9.8								
10/14/02	7.8	7.8	9.6	9.6								
10/09/02	7.9	7.9	9.2	9.0	<0.3	<0.3	<0.005	<0.005	2.6	2.3	<0.25	<0.25
10/06/02	8.0	7.9	9.3	9.1								
09/25/02	7.9	8.0	9.0	8.8								
09/16/02	8.0	7.8	9.4	8.9								
09/10/02	8.0	8.0	9.5	9.2	0.28	0.56	0.0050	0.010	2.0	6.9	<0.23	5.9
09/06/02	8.1	8.0	9.4	9.2								

¹Station W1 is 145 feet upstream of the outfall. Station W3 is 100 feet downstream of the outfall

²Not reported

Staff sampled for unionized ammonia at several stations in the watershed to determine if the unionized ammonia objective was violated. The table below indicates the objective was never violated. The unionized ammonia objective is 0.025 mg/l (as N).

Table 10. Summary of Regional Board Sampling for Unionized Ammonia

Station	Number of Samples	Minimum	Ave rage	Maximum	Start Date	End Date
WW6	8	0.00015	0.001294	0.003	10/29/02	09/17/03
W1	8	0.00015	0.002381	0.005	01/17/03	10/08/03
W3	3	0.002	0.003333	0.005	07/02/03	10/08/03
W5	6	0.00015	0.001858	0.004	01/17/03	07/23/03
EW7	8	0.00015	0.001494	0.004	10/29/2002	09/17/03
LW8	8	0.00015	0.001613	0.004	10/29/02	09/17/03
LWA	6	0.00015	0.002725	0.005	01/16/03	09/17/03
LWMT	7	0.00015	0.002307	0.006	01/16/03	09/17/03

Regional Board staff also sampled for pH. Two pH violations occurred. One occurred at Blooms Creek (station B1). The concentration that violated the objective was 6.91. (The Basin Plan requires pH not be less than 7.0) This station is located in the East Waddell Creek watershed. However, this station is located upstream of the Big Basin State Park discharge. Staff believes the cause of this violation is attributed to naturally alkaline waters. Another violation occurred on the west fork of Waddell Creek (station WW6). The concentration that violated the objective was 6.99. Staff also believes the cause of this violation is naturally alkaline waters.

Table 11. Number of Exceedences of pH Water Quality Objective and Total Data Points at Monitoring Sites Within the Waddell Creek Watershed

	WW6	B1	O1	W1	W3	W4	W5	EW7	LW8	LWA	LW @ B	LWMT
Exceedences/Total Data Points	1/9	1/9	0/9	0/9	0/6	0/0	0/9	0/9	0/9	0/7	0/1	0/8

Regional Board staff also sampled for dissolved oxygen. One dissolved oxygen violation occurred. The violation occurred in the Waddell Creek Estuary on May 20, 2003. The dissolved oxygen violation was 6.5 mg/l. (The Basin Plan objective requires no less than 7.0 mg/l.) This station has minimal flow due to the flat slope.

Table 12. Number of Exceedences of Dissolved Oxygen Water Quality Objective and Total Data Points at Monitoring Sites Within the Waddell Creek Watershed

	WW6	W1	W3	W4	W5	EW7	LW8	LWA	LW @ B	LWMT
Exceedences/Total Data Points	0/9	0/9	0/6	0/0	0/9	0/9	0/9	0/7	0/1	1/8

Staff also sampled for nitrate. No violations of the numeric nitrate objective contained in the Basin Plan occurred.

Table 13. Number of Exceedences of Nitrate Objective and Total Data Points at Monitoring Sites Within the Waddell Creek Watershed

	WW6	B1	O1	W1	W3	W4	W5	EW7	LW8	LWA	LW @ B	LWMT
Exceedences/Total Data Points	0/10	0/10	0/10	0/10	0/7	0/1	0/9	0/10	0/9	0/7	0/1	0/8

The table below provides the nitrate data ranges and averages for each station sampled by the Regional Board staff. Nitrate is also a possible catalyst of biostimulation. However, there is not a biostimulation problem based on dissolved oxygen, pH, and nutrient survey results.

Table 14. Minimum, Maximum, and Average Nitrate Concentrations Within the Waddell Creek Watershed

Station	No. of Samples	Min.	Average	Max.	Start Date	End Date
WW6	10	0.01	0.09	0.15	09/24/02	10/07/03
B1	10	0.01	0.01	0.02	09/24/02	10/08/03
O1	10	0.01	0.01	0.01	09/24/02	10/08/03
W1	10	0.01	0.01	0.02	09/24/02	10/08/03
W3	7	0.01	2.24	6.10	09/24/02	10/08/03
W4	1	5.50	5.50	5.50	09/24/02	09/24/02
W5	9	0.15	1.91	3.41	10/30/02	10/08/03
EW7	10	0.02	0.34	0.71	9/24/2002	10/07/03
LW8	9	0.01	0.10	0.20	10/29/02	10/07/03
LWA	7	0.01	0.07	0.12	01/16/03	10/07/03
LW at Bridge	1	0.05	0.05	0.05	10/29/02	10/29/02
LWMT	8	0.01	0.04	0.13	01/16/03	10/07/03

The figure below displays all the nitrate sample results in comparison to the Basin Plan nitrate numeric objective of 10 mg/l as nitrogen.

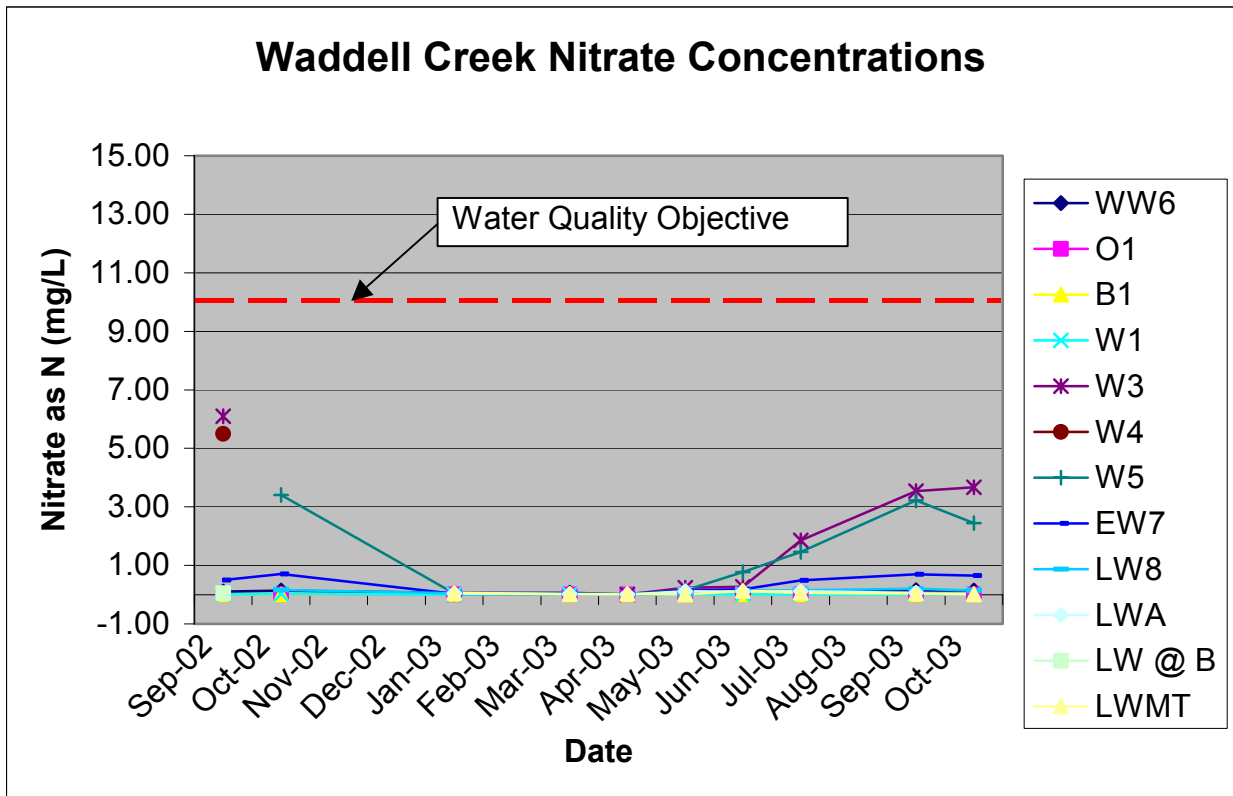


Figure 4. Waddell Creek Nitrate Concentrations

The table below provides the orthophosphate data ranges and averages for each station sampled by the Regional Board staff. Orthophosphate is also a possible catalyst of biostimulation; however, there are no established threshold levels known to cause problems. Since there is no biostimulation problem in the Waddell Creek watershed based on dissolved oxygen, pH, and nutrient survey results, phosphates are not causing impairment.

Table 15. Minimum, Maximum, and Average Ortho Phosphate Concentrations Within the Waddell Creek Watershed

Station	Number of Samples	Minimum	Average	Maximum	Start Date	End Date
WW6	9	0.03	0.09	0.19	09/24/02	10/07/03
B1	8	0.02	0.06	0.15	09/24/02	10/08/03
O1	8	0.01	0.05	0.14	09/24/02	10/08/03
W1	8	0.02	0.05	0.15	09/24/02	10/08/03
W3	7	0.02	0.07	0.15	09/24/02	10/08/03
W4	1	0.06	0.06	0.06	09/24/02	09/24/02
W5	7	0.02	0.06	0.15	03/26/03	10/08/03
EW7	8	0.00	0.05	0.15	9/24/2002	09/17/03
LW8	8	0.02	0.07	0.17	10/29/02	10/07/03
LWA	6	0.03	0.08	0.17	01/16/03	10/07/03
LW at B	1	0.05	0.05	0.05	10/29/02	10/29/02
LWMT	7	0.03	0.07	0.17	03/25/03	10/07/03

5. Rationale For Delisting

The east fork of Waddell Creek should be delisted because neither the numeric nitrate objective nor the narrative objective for biostimulatory substances is being violated. This conclusion is based upon the following information.

1. The California Department of Parks and Recreation, Big Basin State Park (Big Basin) discharge has not violated the unionized ammonia objective since August 17, 2002. (Please see Table 1 on page 3.)
2. Nutrient Indicator Survey Results indicate the biostimulatory objective is not violated. (This is based upon information contained in Table 8. Nutrient Indicator Survey Results are on page 15-16.)
3. The Big Basin benthic macroinvertebrate data collected in the vicinity of the discharge indicates similar results downstream of the discharge compared to upstream results. (Please refer to discussion on page 17)
4. Big Basin monitoring data collected since September 2002 indicates no violations of constituents that may indicate violation of the Basin Plan narrative biostimulatory objective. (See pages 18-20.)
5. The Big Basin monitoring data collected since September 2002 indicates no violations of constituents with numeric water quality objectives. (See pages 18-20.)
6. Regional Board staff sampling of four stations in the east fork of Waddell Creek indicates the numeric unionized ammonia objective is not violated. In addition, four other samples for other sections of the Waddell Creek watershed do not violate the numeric unionized ammonia objective in the Basin Plan. (See Table 10 on page 21.)
7. Regional Board sampling of six stations in the east fork of Waddell Creek indicate the pH objective was violated only once. The violation occurred at a station in the headwaters of the east Fork of Waddell Creek watershed upstream of the Big Basin State Park discharge. One additional violation occurred on the West fork of Waddell Creek. Staff believes these two violations are attributed to natural alkaline waters. (See Table 11 on page 21.)
8. Regional Board sampling of five stations in the east fork of Waddell Creek indicate no violations of the dissolved oxygen objective in the Basin Plan. Only one violation occurred within entire Waddell Creek watershed. This one violation occurred in the estuary and is attributed to minimal flows that occur due to the flat slope of the estuary. (See Table 12 on page 22.)
9. Nitrate and phosphate are not a catalyst for Basin Plan violations based upon the Nutrient Indicator Survey Results (as discussed in item two above), pH results (as discussed in item seven above), and dissolved oxygen concentrations (as discussed in item 8 above).

APPENDIX A

Nutrient Survey Forms

Table XX. October 29 and 30, 2002 Water Quality Indicators Score for Each Station

INDICATOR	STATION				
	WW6	W1	W5	EW7	LW8
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	5	10	9	8	8
2. Color of water due to plants at base or low flow	8	9	9	7	9
3. Fish behavior in hot weather fish kills, especially before dawn	9	Unknown, no fish observed	9	9	7
4. Water use impacts; health effects for whole sub-watershed	8	8	8	8	8
5. Bottom dwelling aquatic organisms	9 ¹	9 ¹	9 ¹	9 ¹	9 ¹
TOTAL SCORE	39	Unknown, no fish observed	44	41	41
RANKING	Excellent	Unknown, no fish observed	Excellent	Excellent	Excellent

Footnote: (1) This score indicates pollution intolerant species occur such as mayflies, stoneflies, caddisflies, water penny, or riffle beetle

Table XX. January 16 and 17, 2003 Water Quality Indicators Score for Each Station

INDICATOR	STATION						
	WW6	W1	W5	EW7	LW8	LWA	LWMT
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	10	10	10	10	10	10	10
2. Color of water due to plants at base or low flow	9	9	9	9	9	9	9
3. Fish behavior in hot weather fish kills, especially before dawn	Unknown, only one fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, only one fish observed	Unknown, no fish observed	Unknown, no fish observed
4. Water use impacts; health effects for whole sub-watershed	8	8	8	8	8	8	8
5. Bottom dwelling aquatic organisms	9 ¹	8 ¹	8 ¹	8 ¹	9 ¹	9 ¹	Not observed-depositional zone (silt covered)
TOTAL SCORE	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed and depositional zone (silt covered) zone
RANKING	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed and depositional zone (silt covered) zone

Footnote: (1) This score indicates intolerant species occur such as mayflies, stoneflies, caddisflies, water penny, or riffle beetle

Table XX. March 25 and 26, 2003 Water Quality Indicators Score for Each Station

INDICATOR	STATION					
	WW6	W1	W5	EW7	LW8	LWA
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	10	10	10	10	9	8
2. Color of water due to plants at base or low flow	9	9	9	9	9	9
3. Fish behavior in hot weather fish kills, especially before dawn	Unknown, only one fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed
4. Water use impacts; health effects for whole sub-watershed	8	8	8	8	8	8
5. Bottom dwelling aquatic organism.	9 ¹	8 ¹	9 ¹	9 ¹	9 ¹	9 ¹
TOTAL SCORE	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed
RANKING	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed

Footnote: (1) This score indicates intolerant species occur such as mayflies, stoneflies, caddisflies, water penny, or riffle beetle

Table XX. April 30 and May 1, 2003 Water Quality Indicators Score for Each Station

INDICATOR	STATION					
	WW6	W1	W5	EW7	LW8	LWA
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	10	10	10	9	9	10
2. Color of water due to plants at base or low flow	9	9	9	9	9	9
3. Fish behavior in hot weather fish kills, especially before dawn	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed
4. Water use impacts; health effects for whole sub-watershed	8	8	8	8	8	8
5. Bottom dwelling aquatic organisms	9 ¹	8 ¹	8 ¹	9 ¹	9 ¹	9 ¹
TOTAL SCORE	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed
RANKING	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed	Unknown, no fish observed

Footnote: (1) This score indicates intolerant species occur such as mayflies, stoneflies, caddisflies, water penny, or riffle beetle

Table XX. May 20 and 21, 2003 Water Quality Indicators Score for Each Station

INDICATOR	STATION									
	WW6	W1	W3	W5	~ 1500 Feet Upstream of EW7	~200 Feet Upstream of EW7	EW7	LW8	LWA	LWMT
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	10	10	10	10	10	10	10	10	10	9
2. Color of water due to plants at base or low flow	9	9	8	9	9	9	9	9	8	8
3. Fish behavior in hot weather fish kills, especially before dawn	9	Unknown, only one fry observed	8	9	Unknown, did not look for fish at this location	9	9	8	Unknown, only one fry seen	8
4. Water use impacts; health effects for whole sub-watershed	8	8	7	8	8	8	8	8	8	8
5. Bottom dwelling aquatic organisms	9 ¹	8 ¹	Unknown, only one caddisfly observed	9 ¹	9 ¹	8 ¹	8 ¹	8 ¹	9 ¹	Not observed-depositional zone (silt covered)
TOTAL SCORE	45	Unknown, only one fry observed	Unknown, only one caddisfly observed	45	Unknown, no fish observed	44	44	43	Unknown, no fish observed	Unknown, depositional zone (silt covered)
RANKING	Excellent	Unknown, only one fry observed	Unknown, only one caddisfly observed	Excellent	Unknown, no fish observed	Excellent	Excellent	Excellent	Unknown, no fish observed	Unknown, depositional zone (silt covered)

Footnote: (1) This score indicates intolerant species occur such as mayflies, stoneflies, caddisflies, water penny, or riffle beetle

Table XX. July 1 and 2, 2003 Water Quality Indicators Score for Each Station

INDICATOR	STATION									
	WW6	W1	W3	W5	~ 1500 Feet Upstream of EW7	~200 Feet Upstream of EW7	EW7	LW8	LWA	LWMT
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	10	10	10	10	10	10	10	10	10	10
2. Color of water due to plants at base or low flow	9	9	9	9	9	8	9	9	9	9
3. Fish behavior in hot weather fish kills, especially before dawn	9	Unknown, no fish observed	9	9	9	9	9	9	9	9
4. Water use impacts; health effects for whole sub-watershed	8	8	8	8	8	8	8	8	8	8
5. Bottom dwelling aquatic organisms	9 ¹	8 ¹	8 ¹	8 ¹	9 ¹	9 ¹	9 ¹	9 ¹	9 ¹	Not observed-depositional zone (silt covered)
TOTAL SCORE	45	Unknown, no fish observed	44	44	45	44	45	45	45	Unknown, depositional zone (silt covered)
RANKING	Excellent	Unknown, no fish observed	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Unknown, depositional zone (silt covered)

Footnote: (1) This score indicates intolerant species occur such as mayflies, stoneflies, caddisflies, water penny, or riffle beetle

Table XX. July 22 and 23, 2003 Water Quality Indicators Score for Each Station

INDICATOR	STATION									
	WW6	W1	W3	W5	~ 1500 Feet Upstream of EW7	~200 Feet Upstream of EW7	EW7	LW8	LWA	LWMT
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	10	10	10	10	10	9	10	10	10	10
2. Color of water due to plants at base or low flow	9	9	9	9	9	9	9	9	9	9
3. Fish behavior in hot weather fish kills, especially before dawn	9	9	9	9	9	9	9	9	9	9
4. Water use impacts; health effects for whole sub-watershed	8	8	8	8	8	8	8	8	8	8
5. Bottom dwelling aquatic organisms	9 ¹	8 ¹	8 ¹	8 ¹	9 ¹	9 ¹	9 ¹	9 ¹	9 ¹	Not observed-depositional zone (silt covered)
TOTAL SCORE	45	44	44	44	45	44	45	45	45	Unknown, depositional zone (silt covered)
RANKING	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Unknown, depositional zone (silt covered)

Footnote: (1) This score indicates intolerant species occur such as mayflies, stoneflies, caddisflies, water penny, or riffle beetle

Table XX. September 17 and 18, 2003 Water Quality Indicators Score for Each Station

INDICATOR	STATION									
	WW6	W1	W3	W5	~ 1500 Feet Upstream of EW7	~200 Feet Upstream of EW7	EW7	LW8	LWA	LWMT
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	10	10	10	7	10	6	10	10	8	7
2. Color of water due to plants at base or low flow	9	9	9	9	9	9	9	9	9	Not applicable—recent creek mouth closure resulted in disturbed fine substrate
3. Fish behavior in hot weather fish kills, especially before dawn	Unknown, no fish observed	Unknown, no fish observed	9	9	9	9	9	9	9	9
4. Water use impacts; health effects for whole sub-watershed	8	8	8	8	8	8	8	8	8	8
5. Bottom dwelling aquatic organisms	9 ¹	8 ¹	8 ¹	8 ¹	9 ¹	8 ¹	9 ¹	9 ¹	9 ¹	Not observed-depositional zone (silt covered)
TOTAL SCORE	Unknown, no fish observed	Unknown, no fish observed	44	41	45	40	45	45	43	Unknown, depositional zone (silt covered)
RANKING	Unknown, no fish observed	Unknown, no fish observed	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Unknown, depositional zone (silt covered)

Footnote: (1) This score indicates intolerant species occur such as mayflies, stoneflies, caddisflies, water penny, or riffle beetle

Table XX. October 7 and 8, 2003 Water Quality Indicators Score for Each Station

INDICATOR	STATION									
	WW6	W1	W3	W5	~ 1500 Feet Upstream of EW7	~200 Feet Upstream of EW7	EW7	LW8	LWA	LWMT
1. Total amount of aquatic vegetation at low flow or in pooled areas. Includes rooted and floating plants, algae, mosses & periphyton	10	10	10	8	10	4	10	8	8	10
2. Color of water due to plants at base or low flow	9	9	9	9	9	6	9	9	9	7
3. Fish behavior in hot weather fish kills, especially before dawn	9	Unknown, no fish observed	9	9	9	9	9	9	9	9
4. Water use impacts; health effects for whole sub-watershed	8	8	8	8	8	5	8	8	8	8
5. Bottom dwelling aquatic organisms	9 ¹	8 ¹	8 ¹	9 ¹	9 ¹	8 ¹	9 ¹	9 ¹	9 ¹	Not observed-depositional zone (silt covered)
TOTAL SCORE	45	Unknown, no fish observed	44	43	45	32	45	43	43	Unknown, depositional zone (silt covered)
RANKING	Excellent	Unknown, no fish observed	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Unknown, depositional zone (silt covered)

Footnote: (1) This score indicates intolerant species occur such as mayflies, stoneflies, caddisflies, water penny, or riffle beetle